

Earthworms (Lumbricidae) of the Bohemian Forest

Václav Pižl

*Institute of Soil Biology, Academy of Sciences of the Czech Republic, Na Sádkách 7, CZ-37005
České Budějovice, Czech Republic
pizl@uph.cas.cz*

Abstract

All historical data available on the occurrence of earthworms on the territory of the Bohemian Forest are listed and new records are given obtained in 1982–2000. In total 1382 earthworm individuals were collected during both occasional samplings and scientific projects at 24 localities, among which 17 species and subspecies of earthworms were identified. Of those, *Dendrobaena pygmaea* was recorded for the first time from Bohemia and additional 4 taxa were new for the Bohemian Forest. Including the literature data, the list of earthworms known from the Šumava NP and PLA comprises 22 taxa, i.e. 42% of the earthworm fauna of the Czech Republic. There were strong differences among the diversity of earthworm faunas at individual localities depending on the type of ecosystems and soils. Acidophilous spruce forests possessed poor but very specific earthworm assemblages built of acidotolerant epigeic species. In contrast, relatively rich assemblages inhabited non-forest localities with deeper slightly acid soils as well as beech forests, spruce forests in various degrees of degradation and ecotones. Per site density of earthworms ranged from 3.2 to 166.7 individuals.m⁻² and was generally higher in mountain meadows than in spruce forests and/or clear-cut areas.

Key words: soil fauna, earthworms, Šumava Mts., spruce forests, meadows

INTRODUCTION

The first records of earthworms from the territory of the Bohemian Forest date back to the second half of the 19th century. Vejdovský reviewed the records of two species made by Frič in his paper published in 1875: *Lumbricus purpureus* (= *Lumbricus rubellus*) from the vicinity of Sušice (outside the borders of contemporary National Park and Protected Landscape Area) and *Lumbricus puter* (= *Dendrodrilus rubidus*) from an undefined locality near the Plechý Mt. (VEJDOVSKÝ 1875). While the first record seems to be valid according to a revision by Zicsi (ZICSI 1961), the second one is uncertain as the collection material failed and Vejdovský himself re-classified those worms to *Lumbricus roseus* (= *Aporrectodea rosea*) in his subsequent paper (VEJDOVSKÝ 1883). In the last paper, information is also to be found about the findings of *L. roseus* and *L. purpureus* in the environs of Železná Ruda (VEJDOVSKÝ 1883). Later, Michaelsen (MICHAELSEN 1907) reported the findings of *Lumbricus baicalensis* in the Boubín Mt. More faunistic data were presented by Černosvitov, who reported 16 earthworm species in his Monograph of Czechoslovak Earthworms (ČERNOSVITOV 1935), most of them found in the environs of Domažlice. Two Černosvitov's localities only belong to the territory of the current NP Šumava: (1) the bank of the Čertovo Lake, where *Dendrobaena illyrica* var. *hintzei* (= *Dendrobaena illyrica*) and *Lumbricus pusillus* (= *L. baicalensis*) were found, and (2) the bank of the Černé Lake, from which a new species *Bimastus vej dovskyi* (= *Dendrobaena vej dovskyi*) was described.

An important contribution to the knowledge of earthworm fauna in the Šumava NP and PLA represented only papers by Mikulová (MIKULOVÁ 1973, 1975) summarising the results of systematic faunistic research carried out by the workers of the National Museum in Prague. They received data about the occurrence of 16 worm species at 29 localities (Table 1) during four sampling excursions (surrounding of the Lipno water reservoir in 1962, and vicinity of Horská Kvilda village, Boubín and Špičák Mounts in 1972). In most cases however the papers do not contain information allowing adjoining individual species to particular localities. The only exceptions are the records of *Octolasion croaticum* v. *argoviense* (= *Octodrilus argoviensis*) on the bank of the Hamerský Potok stream between Horská Kvilda and Antigl, and those of *Dendrobaena platyura* (= *Fitzingeria platyura*) in a meadow soil under the Stožec Mt. In addition, MIKULOVÁ (1975) mentioned the record of *Lumbricus polyphemus* made by Štěpánek near Černá v Pošumaví village in 1953.

MATERIAL AND METHODS

In total, earthworms were studied at 24 localities. They were collected by hand in a number of micro-habitats (qualitative sampling) of the most localities to obtain as many records of variously specialised species as possible. To determine quantitative parameters of earthworm

Table 1. List of earthworm species and subspecies recorded from the Bohemian Forest. For localities – see Material and Methods.

	MIKULOVÁ (1975)	This study (localities)
<i>Allolobophora eiseni</i> (Levinsen, 1884)	–	18
<i>Aporrectodea caliginosa caliginosa</i> (Savigny, 1826)	+	2, 5, 8, 10, 14, 23, 24
<i>Aporrectodea handlirschi handlirschi</i> (Rosa, 1897)	+	–
<i>Aporrectodea rosea rosea</i> (Savigny, 1826)	+	5, 8, 10, 11, 24
<i>Dendrobaena attemsi attemsi</i> (Michaelsen, 1902)	–	3, 4, 5
<i>Dendrobaena illyrica</i> (Cognetti, 1906)	+	1, 4–6, 9, 11–14, 16–21
<i>Dendrobaena octaedra</i> (Savigny, 1826)	+	1, 2, 4–9, 11, 14–19, 21, 23, 24
<i>Dendrobaena pygmaea</i> (Savigny, 1826)	–	7
<i>Dendrobaena vejdoovskyi</i> (Černosvitov, 1935)	+	1, 6, 9, 12, 13, 18–21, 23
<i>Dendrodrilus rubidus rubidus</i> (Savigny, 1826)	+	4–8, 10, 17, 18, 20, 21
<i>Dendrodrilus rubidus tenuis</i> (Eisen, 1874)	–	18, 21, 23
<i>Eisenia fetida fetida</i> (Savigny, 1826)	+	–
<i>Eiseniella tetraedra tetraedra</i> (Savigny, 1826)	+	5, 9
<i>Fitzingeria platyura platyura</i> (Fitzinger, 1833)	+	–
<i>Lumbricus baicalensis</i> Michaelsen, 1900	+	10
<i>Lumbricus castaneus</i> (Savigny, 1826)	+	8, 23
<i>Lumbricus polyphemus</i> (Fitzinger, 1883)	+	–
<i>Lumbricus rubellus rubellus</i> Hoffmeister, 1843	+	2, 5, 7–9, 11, 14, 15, 18, 21–24
<i>Lumbricus terrestris</i> Linnaeus, 1758	+	–
<i>Octodrilus argoviensis</i> (Bretscher, 1899)	+	14
<i>Octolasion lacteum</i> (Savigny, 1826)	+	5, 8–11, 14, 22–24
<i>Octolasion tyrtaeum</i> (Savigny, 1826)	–	5
Total number of species and subspecies	17	17

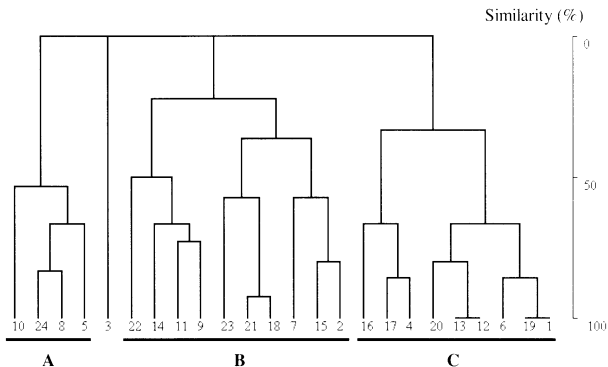


Fig. 1. Bray-Cyrtis Cluster Analysis (BioDiversity-Professional Programme) of earthworm fauna of individual localities based on the species similarity. A – grasslands and water sources. B – beech and rich spruce forests. C – poor spruce forests. 1–24 – localities, see Material and Methods.

assemblages, soil cores were taken at several localities (five per site, measuring 625 cm² in area × 10–15 cm in depth), transported into the laboratory and extracted by heat using the modified Kempson apparatus (KEMPSON et al. 1963). In addition, epigeically active worms were collected using pitfall traps (five per site, openings of 78.5 cm²). The lumbricids obtained were fixed in 4% formalin and stored in 7% solution of the same fixative. The nomenclature of earthworms follows EASTON (1983).

1. Blatný Vrch Mt., NW slope, damaged spruce forest – 2 sites, quantitative sampling: 8 Jun 1999, 12 Aug 1999, 5 Oct 1999, 8 Aug 2000, 4 Oct 2000.
2. Boubín Mt., S slope, grassland, qualitative sampling: 30 Apr 1995.
3. Boubín Mt., spruce forest in the Nature Reserve, qualitative sampling: 30 Apr 1995.
4. Boubín Mt., NW slope, spruce forest – 2 sites, quantitative sampling: 27 May 1993, 6 Oct 1993, 19 Oct 2000, pitfall trapping: 22 May – 25 Aug 1992, 22 Aug 1992 – 27 May 1993, 27 May – 6 Sep 1993.
5. Boubín Mt., W slope, water source, qualitative sampling: 27 May 1993, 6 Nov 1993.
6. Březnický Les, SE slope of the Studená Hora Mt., 2 sites – acidophilous spruce forest and clearing, quantitative sampling: 8 Jun 1999, 12 Aug 1999, 5 Oct 1999, 8 Aug 2000, 4 Oct 2000.
7. Buzošná, bank of the stream, qualitative sampling: 7 Jul 1998, 15 Oct 1998, 6 May 1998.
8. Dobrá village, meadow, qualitative sampling: 27 Aug 1982.
9. Modrava village, spruce forest on the brook bank, qualitative sampling: 15 Jun 1985.
10. Mrtvý Luh, peat meadow, qualitative sampling: 27 Aug 1982.
11. Nové Hutě village, meadow, qualitative sampling: 27 Aug 1982.
12. Plechý Mt., NE slope, spruce forest – 2 sites, quantitative sampling: 19 Oct 2000.
13. Plechý Mt., top part, spruce forest, qualitative sampling: 28 May 1986.
14. Plešné Lake, grassland on bank, qualitative sampling: 28 May 1986.

Table 2. The lowest (min.) and highest (max.) mean density of earthworms (ind.m⁻² ± S.D.) in selected types of ecosystems. Loc. – locality, see Material and Methods.

Density		Loc.	Density		Loc.
Rich spruce forests <i>Calamagrostio villosae-Fagetum</i>			Clearings <i>Junco-Calamagrostietum villosae</i>		
min.	16.0 ± 27.7	16	min.	12.8 ± 20.9	6
max.	83.2 ± 48.5	1	max.	83.2 ± 118.3	17
Poor spruce forests <i>Athyrio alpestris-Piceetum</i>			Meadows <i>Violion caninae</i>		
min.	3.2 ± 7.2	12	min.	48.0 ± 45.3	24
max.	12.8 ± 20.9	12	max.	166.7 ± 18.2	24

15. Plešné Lake, spruce forest on NW bank, qualitative sampling: 2 Sep 1982.
16. Ptačí Nádrž, NW from the Mrtvý Vrch Mt., 2 sites – eutrophic spruce forest and clearing, quantitative sampling: 8 Jun 1999, 12 Aug 1999, 5 Oct 1999, 8 Aug 2000, 4 Oct 2000.
17. Roklanský Potok stream, acidophilous clearing, quantitative sampling: 8 Jun 1999, 12 Aug 1999, 5 Oct 1999, 8 Aug 2000, 4 Oct 2000.
18. Smrčina Mt. near Nová Pec, beech forest – 2 sites, pitfall trapping: 26 Aug 1997 – 2 Jun 1998.
19. Smrčina Mt. near Nová Pec, wet spruce forest – 2 sites, quantitative sampling: 19 Oct 2000.
20. Smrčina Mt. near Nová Pec, spruce forest – 2 sites, pitfall trapping: 26 Aug 1997 – 2 Jun 1998.
21. Studená Hora Mt., NS slope, 2 sites – acidophilous spruce forest and clearing, quantitative sampling: 12 Aug 1999, 5 Oct 1999, 8 Aug 2000, 4 Nov 2000.
22. Vydra River valley near Antigl, spruce forest, qualitative sampling: 8 May 1993.
23. Zdíkov, spruce forest – meadow ecotone, qualitative sampling: 27 Aug 1982.
24. Zhůří, Huťská Hora Mt., meadow, 4 differently managed sites, quantitative sampling: 11 May 1999, 19 Jul 1999, 28 Sep 1999.

In total 1382 earthworm individuals were collected. The material is deposited in the collections of the Institute of Soil Biology AS CR in České Budějovice.

RESULTS AND DISCUSSION

In total 17 species and subspecies of earthworms were identified (Table 1). Of those, *Dendrobaena pygmaea* was recorded for the first time from the territory of Bohemia and additional 4 taxa, namely *Allolobophora eiseni*, *Dendrobaena attemsi*, *Dendrodrilus rubidus tenuis* and *Octolasion tyrtaeum*, were new for the Bohemian Forest. Including the literature data, the list of earthworms known from the territory of the Šumava National Park and Protected Landscape Area comprises 22 species and subspecies, i.e. 42% of the earthworm fauna of the Czech Republic.

A frequency analysis revealed that epigeic worms *Dendrobaena octaedra*, *D. illyrica* and *Lumbricus rubellus* represent the core species characterised by a frequency higher than 50% (Table 1). In contrast, subcorticolous *Allolobophora eiseni*, the species known to prefer native deciduous forests (Přízl 1994), *Dendrobaena pygmaea*, the species previously found in our country from the Podyjí National Park (Přízl 1998), *Lumbricus baicalensis*, a typical inhabitant of the Sudeten Mountains, and two hygrophilous species, *Octodrilus argoviensis* and *Octola-*

sion tyrtaeum, were only recorded from one locality. Additionally, the record of *Dendrobaena attemsi* belongs to those of importance from the faunistic point of view. In the Czech Republic, that species was only known from the Bohemian Switzerland National Park (Pízl 1997).

Differences in species composition between the faunas of individual localities are shown in Fig. 1. Three main clusters may be recognised in this respect. The first cluster (A) comprises non-forest localities (meadows and water sources) with deeper slightly acid soils inhabited by qualitatively (Table 1) rich worm assemblages composed of both epigeic and endogeic species. However, while meadows possessed assemblages formed by euryecious earthworms only (a typical species combination *D. octaedra* – *A. caliginosa* – *L. rubellus*), stenoecious species (*Eiseniella tetraedra*, *O. tyrtaeum*) were additionally registered in water sources. The second cluster (B) puts together beech forests, spruce forests in various degrees of degradation and ecotones. Such localities are characterised with relatively rich assemblages composed mainly of straminicolous, detritophagous and subcorticolous earthworms (LEE 1985); the proportion of endogeic species is low. The third cluster represents non-degraded (mainly acidophilous) spruce forests with very poor earthworm assemblages (Table 1), built exclusively of acidotolerant epigeic species. Nevertheless, some of those assemblages, e.g. *D. attemsi* – *D. illyrica* – *D. rubidus* in the Boubín Mt., or *D. vejvodskyi* – *D. illyrica* – *D. octaedra* at a number of localities (1, 6, 12, 13, 19) seem to be very specific, found in the Bohemian Forest only.

Earthworm density varied largely among individual sites, ranging from 3.2 to 166.7 individuals.m⁻² in the Plechý Mt. and Zhůří, respectively. Generally, worm densities were much higher in mountain meadows than in spruce forests and clear-cut areas (Table 2).

In conclusion, I have to say that the knowledge of the earthworm fauna in the Bohemian Forest is far from to be complete. So, this study provides a basis for currently started projects undertaken by the Institute of Soil Biology AS CR, which contribute towards a better understanding of soil invertebrates distribution on this territory.

Acknowledgement. Financial support for this study was provided by the Grant Agency of the Czech Republic (grants 206/99/1410 and 206/99/1416) and the Ministry of the Environment of the Czech Republic (project R&D 610/10/2000). In addition, I would like to thank K. Tajovský and J. Starý (ISB AS CR), and L. Dvořák and L. Bufka (Šumava National Park and PLA Administration) for providing a part of the material and/or their help during the fieldwork.

REFERENCES

- ČERNOSVITOV L., 1935: Monografie československých dešťovek [Monograph of Czechoslovak earthworms]. *Archiv pro přírodovědecký výzkum Čech*, 19: 1–86 (in Czech).
- EASTON E.G., 1983: A guide to valid names of Lumbricidae (Oligochaeta). In: *Earthworm ecology from Darwin to vermiculture*, SATCHELL J.E. (ed.) Chapman and Hall, London, pp. 241–246.
- KEMPMON D., LLOYD M. & GHELARDI R., 1963: A new extractor for woodland litter. *Pedobiologia*, 3: 1–21.
- LEE K.E., 1985: *Earthworms, their ecology and relationships with soils and land use*. Academic Press, Sydney, 411 pp.
- MICHAELSEN W., 1907: Zur Kenntnis der deutschen Lumbricidenfauna. *Mitteilungen aus dem Naturhistorischen Museum, Hamburg*, 24: 187–193.
- MIKULOVÁ M., 1973: *Octolasion croaticum* v. *argoviense* (Bretscher, 1899) und *Dendrobaena platyura* (Fitz., 1833) v. ? (Olig., Lumbr.) – zwei zum erstenmal in Böhmerwald gefundene Arten. *Věstník Československé společnosti zoologické*, 37: 23–26.
- MIKULOVÁ M., 1975: Přispěvek k poznání fauny žižal (Oligochaeta, Lumbricidae) Chráněné krajinné oblasti Šumava [Contribution to the knowledge of earthworm fauna (Oligochaeta, Lumbricidae) of the Šumava Protected Landscape Area]. *Šorník Jihočeského muzea v Českých Budějovicích, Přírodní vědy*, 15: 187–194 (in Czech).
- PÍZL V., 1994: Supplementary records of earthworms (Lumbricidae) in the Czech Republic. *Acta Societatis Zoologicae Bohemicae*, 58: 205–211.
- PÍZL V., 1997: Žižaly (Oligochaeta, Lumbricidae) chráněné krajinné oblasti Labské pískovce [Earthworms (Oligo-

- chaeta, Lumbricidae) of the Protected Landscape Area Labské pískovce]. *Sborník Okresního muzea v Mostě, řada přírodovědecká*, 19: 9–18 (in Czech).
- PIZL V., 1998: Žížaly (Oligochaeta, Lumbricidae) Národního parku Podyjí [Earthworms (Oligochaeta, Lumbricidae) of the National Park Podyjí]. *Thayensia*, 1: 153–166 (in Czech).
- VEJDOVSKÝ F., 1875: Vorläufige Uebersicht der bis jetzt bekannten Anneliden Böhmens. *Sitzung der mathematisch-naturwissenschaftlichen Classe der königlichen böhmischen Gesellschaft der Wissenschaften*, p. 1–7.
- VEJDOVSKÝ F., 1883: Revisio Oligochaetorum Bohemiae. *Sitzung der mathematisch-naturwissenschaftlichen Classe der königlichen böhmischen Gesellschaft der Wissenschaften*, p. 1–16.
- ZIČKA A., 1961: Revize sbírky lumbricidů prof. dr. F. Vejdovského [Revision der Lumbriciden von Prof. Dr. F. Vejdovsky]. *Casopis Národního Muzea v Praze, oddíl přírodovědný*, 130: 77–80 (in Czech).